

Waterways at Risk

How Low-Impact Development
Can Reduce Runoff Pollution in Michigan

Travis Madsen
Mike Shriberg

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PIRGIM Education Fund
103 E. Liberty, Suite 202
Ann Arbor, MI 48104

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Executive Summary

Many communities in Michigan are developing in ways that create water quality problems in the Great Lakes and inland waterways.

Runoff from developed land contaminates waterways with pollution after rainstorms. Construction of roads and buildings replaces natural surfaces that store and clean rainwater with hard, impervious surfaces (like pavement) that divert water and pollution directly into creeks or into sewers. As a result, community growth can lead to higher levels of contaminated runoff, impaired drinking water quality, degraded wildlife habitat and uncontrolled sewage overflows.

One quarter of Michigan watersheds are impacted by or vulnerable to contaminated runoff from developed land.

- 5 percent of Michigan watersheds are impacted, with more than 15 percent of their land area covered by pavement and other impervious surfaces.
- Another 4 percent are moderately impacted, with between 10 and 15 percent impervious cover; and
- 15 percent of Michigan's watersheds are vulnerable to developing significant

water quality problems as a result of expanded development, with between 5 and 10 percent impervious cover as of 2001. (See Figure ES-1.)

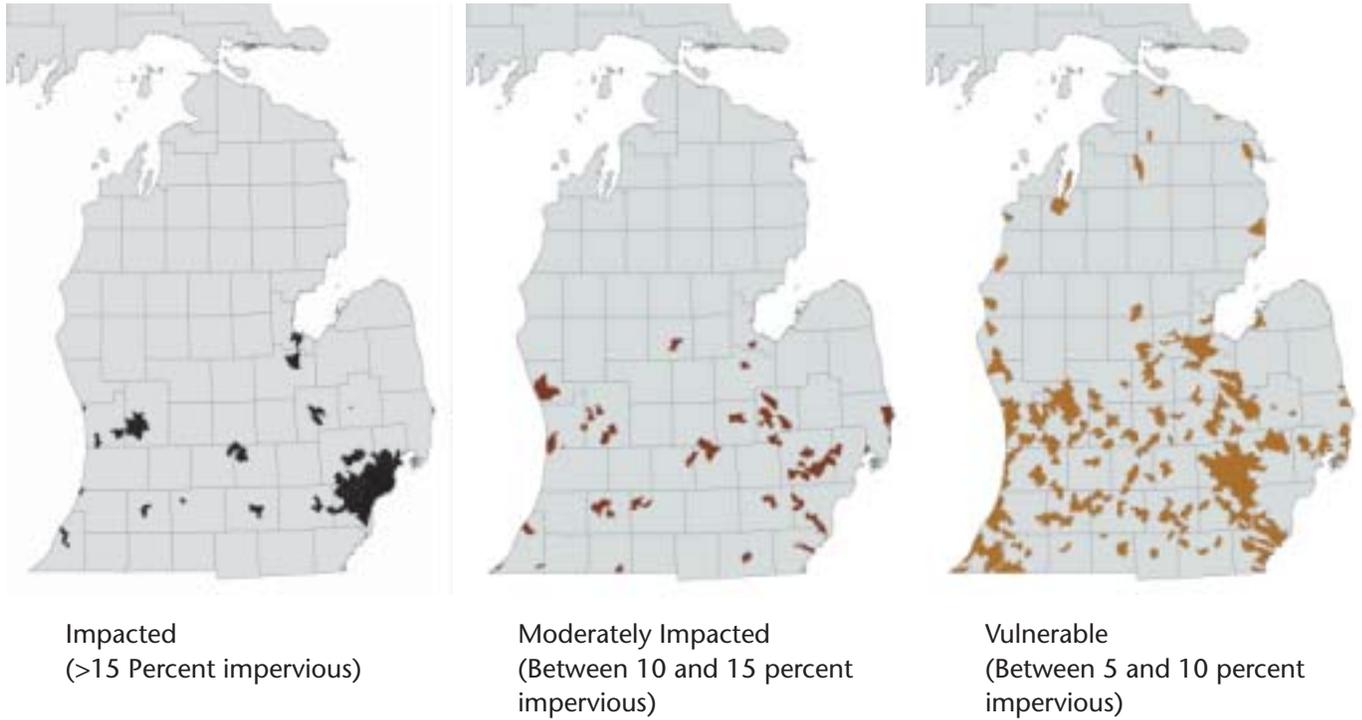
- According to a 2001 forecast, Michigan will add over 4 million acres of new development by 2040, nearly tripling the amount of built land. Development on this scale threatens to pollute inland waterways and increase downstream impacts in the Great Lakes.

Watersheds in rapidly developing communities are most at risk, including areas surrounding Detroit and Grand Rapids, plus smaller areas near Kalamazoo, Lansing and Traverse City.

Municipalities that issued more than 200 building permits for single family homes in 2004 and occupy watersheds vulnerable to water quality decline include:

- **Southwest Detroit Metro Area:** Ann Arbor, Ypsilanti, Superior, Canton, Van Buren, Romulus, Huron, Brownstown and Bedford;
- **Northwest Detroit Metro Area:** Clinton, Sterling Heights, Troy, Chesterfield, Macomb, Shelby,

Figure ES-1: Impervious Cover in Michigan Watersheds



Rochester Hills, Washington, Oxford, Independence, White Lake, Commerce, Novi, Northville, Davison, Grand Blanc, Holly, Mundy, Brighton and unincorporated Livingston County;

- **Grand Rapids Area:** Lowell, Plainfield, Gaines, Byron, Wyoming, Georgetown and Holland;
- **Additional Areas:** Portage, Delhi, Union, and Grand Traverse County. (See Figure ES-2.)

Poorly designed development can cause water pollution, but development using innovative low-impact development and smart growth principles can greatly reduce runoff and prevent harm.

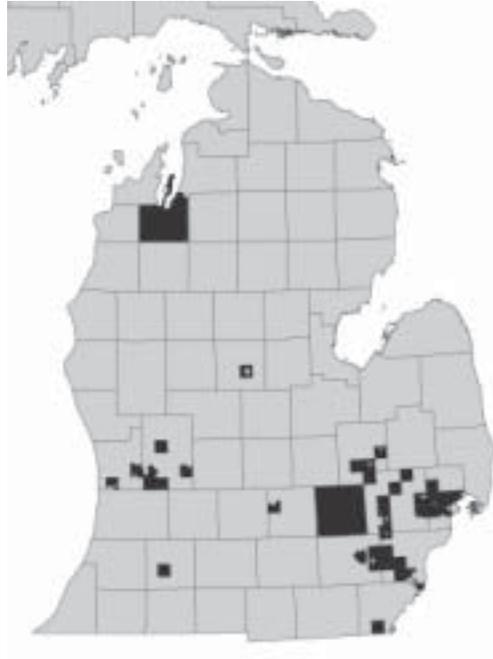
- Poorly designed developments treat stormwater runoff as a waste product, creating more runoff at a given site by using gutters and drains to dispose of

runoff in ponds, creeks and sewers.

The problem is aggravated by sprawling growth patterns that create larger amounts of runoff for a given number of residents. For example, a community of low-density development with a large network of roadways along a river will impact a larger area and cause greater amounts of runoff than a high-density, low-impact development, while disrupting the natural water cleaning ability of the land around the waterway.

- In contrast, low-impact development techniques replicate the natural functions of the environment on-site, using green spaces, native landscaping, and a variety of other simple, cost-effective and low-tech methods to capture and treat stormwater close to where it falls. In addition, smart growth practices reduce the area of impact and protect critical parts of

Figure ES-2: Rapidly Developing Areas At Risk of Water Quality Decline



the ecosystem by using strategic open spaces, infill development and redevelopment, and clustered, higher-density design—minimizing runoff in the aggregate.

Local governments have the power to promote smart growth and low-impact development.

Local governments can protect and restore local waterways by establishing riparian buffer zones, requiring no net runoff from new developments and implementing smart growth strategies. These policies can be included in community master plans

and stormwater management plans, and included as legal requirements in zoning ordinances. Local governments should:

- Establish a natural buffer zone around creeks, streams or rivers. The state of New Jersey applies a 150- to 300-foot buffer zone to protect valuable drinking water supplies and their upstream headwaters.
- Change zoning policy in areas outside the urban core to require no net runoff from new developments. On-site measures should be capable of replicating pre-development runoff rates during a 2-year, 24-hour storm.
- Allow more flexibility in zoning policy to accommodate low-impact development principles. For example, zoning rules with strict requirements for wide streets or traditional stormwater infrastructure should be modified to allow equally effective low-impact strategies.
- Initiate low-impact retrofit programs in urban core areas like Detroit, Grand Rapids, Flint, Saginaw and Lansing to mitigate the impact of existing development.
- Couple riparian buffers, “no net runoff” and retrofit policies with broader smart growth strategies, including incentives for clustered development around town centers, infill development and redevelopment, strategic open land preservation and coordinated planning across local and regional boundaries. A comprehensive approach to growth will magnify the benefit of individual policies—leading to cleaner water locally and in the Great Lakes.

Introduction: Restoring the Great Lakes Through Local Government

The Great Lakes and urban waterways in Michigan have suffered serious abuse since the first days of settlement. First forests were cleared, causing runoff and erosion. Then factories were built along rivers and lakeshore, complete with waste pipes leading directly to the water. Industrial pollution caused serious toxic contamination and declines in water quality, and a corresponding loss of plant and animal life. These trends continued unchecked until the environmental regulations of the late 1960s and early 1970s—especially the Clean Water Act of 1972—established limits on direct pollution of Michigan waters.

However, it has become increasingly clear that simply controlling industrial pollution is not enough to restore and protect Michigan waterways and the Great Lakes. The progress achieved in the last 15 years has stalled, and some positive trends have reversed. As stated in *The Great Lakes Green Book*: “We are going in the wrong direction.”¹

Irresponsible land use is now one of the most important threats facing the Great Lakes and inland waterways. Sprawling development and highway expansion create contaminated runoff. The pace and intensity of development increases the

volume of water running through municipal systems. Impervious surfaces prevent the soil from absorbing waste accumulated in stormwater, and instead serve as a swift conduit to transmit that waste into the Lakes and connected waterways. In addition to causing direct runoff into the Lakes, these practices strain the capacity of municipal water treatment, resulting in sewage overflows, drinking water contamination and beach closings. Moreover, development is overtaking wetlands and other crucial habitats.

In contrast to industrial pollution, land use does not have defined discharge points that can be easily identified and regulated. To restore and protect the Great Lakes, Michigan needs to restore and protect the health of inland waterways. Since the source of the pollution is diffuse, the response must be distributed as well.

More than 70 organizations representing millions of residents in the region have joined a new coalition to restore and protect the Great Lakes. The Healing Our Waters-Great Lakes Coalition seeks to secure a sustainable restoration plan—including a plan to stop stormwater pollution—and the billions of dollars of state and federal funding needed to implement it.

The coalition is currently working to develop a consensus Great Lakes restoration plan through the Great Lakes Regional Collaboration, led by the U.S. Environmental Protection Agency. The draft *Action Plan to Restore and Protect the Great Lakes* released in July 2005 calls for nearly \$14 billion in new funding to help municipalities across the region plan and implement effective stormwater programs, with emphasis on comprehensive stormwater management, including low-impact development and other “soft-path” controls. The plan also sets a goal of virtually eliminating sewage overflows, primarily caused by stormwater infiltration of sewage systems, by 2020.

Implementing the plan will require action by Congress and the Great Lakes states. However, if done right, local governments will be doing most of the real work to stop runoff pollution—making individual development decisions, promoting smart growth patterns and encouraging innovative measures to prevent contaminated runoff at the source. Innovative

low-impact development techniques can allow a community to grow while reducing the impact of development on inland water resources. They can also restore natural functions to existing urban areas and encourage revitalization, reducing pollution.

This report documents where development is occurring in Michigan and identifies areas of the state vulnerable to water quality decline. It also suggests policy ideas for local government to use in protecting water resources from new development or in restoring impaired waterways in urban areas. Taking advantage of these policies, local government in Michigan can play a central role in restoring and protecting local water resources and the Great Lakes.

For More Information

For more information on the Healing Our Waters-Great Lakes Coalition, visit www.restorethelakes.org.



Lake Michigan from Empire, MI.

Sprawling Development Is Polluting Michigan's Water

Despite progress in controlling industrial water pollution over the last 30 years, water quality problems in Michigan persist. Most urban and suburban watersheds, and the near-shore areas of Great Lake cities, still do not have water that:²

- is safe for swimming;
- contains fish that are safe to eat; or
- supports diverse communities of plants and wildlife.

The Michigan Department of Environmental Quality (DEQ) monitors the status of lakes and rivers across the state. In the latest water quality report, the DEQ found that:³

- 80 miles of Michigan's Great Lakes shoreline is too polluted for use as a public water supply.
- More than a quarter of Michigan's inland lakes have high nutrient levels, which contribute to algae blooms, low oxygen levels and poor conditions for wildlife.

- At least 25 percent of the stream miles in Michigan tested between 1997 and 2003 did not fully support wildlife, swimming, drinking or fish consumption.
- Many impaired waterways are located in the southern half of the Lower Peninsula, near the majority of Michigan's population.

Irresponsible land use is one of the primary factors behind water pollution.⁴ In particular, paving land increases the amount of runoff after rainstorms and seeds the runoff with contamination.

After heavy rainfall, water flows down rooftops, sidewalks, parking lots and streets, carrying everything from sediment to pesticides into waterways. In some areas, runoff overwhelms outdated sewage infrastructure, spilling raw or partially-treated sewage into waterways.

As a result, Michigan's streams, rivers and lakes become less suitable for drinking and less able to support a diverse community of wildlife. Areas downstream become more prone to flooding and sewage overflows. And the pollution ends up in the Great Lakes.

Development Is Increasing Faster Than Population Growth

Michigan is developing in ways that aggravate water quality problems. Between 1982 and 1997, developed land in the state increased by more than 30 percent.⁵ New homes, shopping centers and businesses continued to move away from city centers into once-rural areas.

Land use grew much faster than population across much of the state. In some places, such as the Detroit and Saginaw metro areas, land use increased more than ten times faster than population.⁶

The trend toward this type of sprawling growth is readily apparent in Southeast Michigan:⁷

- Between 1990 and 2000, developed land increased by 17 percent, while population only increased by 5 percent.
- Almost half of the growth in land use was due to decreasing density of new residential areas.



- People leaving urban Detroit for the suburbs aggravated the trend. During the decade, over 7 square miles of land in urban Detroit became vacant.
- Most of the land available for future development is in outlying parts of the region, where plans and zoning specify low-density development typified by larger homes on larger lots.

This type of growth increases dependence on the automobile and requires more roads and paved land to serve a smaller number of people. Paving natural areas can have serious consequences for water quality, both locally and in areas downstream.

Development Causes Contaminated Runoff

Paving land with hard surfaces causes increased levels of stormwater runoff, which carries pollutants from roads, rooftops and parking lots into creeks and rivers.

When rain falls on natural, undeveloped land, water is captured by leaves, branches, ground cover, roots or soil. At Michigan's latitude and with its climate, much of the rain eventually evaporates back into the air. The remaining water either flows into a stream or filters underground into the water table.⁸ In the process, vegetation and soils filter and clean the water of sediment and pollution.⁹

However, when natural landscape is replaced with a road, a driveway or a building, the ground becomes less able to capture water. Concrete, asphalt and rooftops do not absorb water. Instead, these impervious surfaces create runoff, directing large volumes of rainfall into gutters, trenches, canals and storm sewers.

High volumes of this runoff quickly reach nearby creeks, rivers and lakes:¹⁰

- Replacing a meadow with a parking lot increases runoff by about 16 times.¹¹

- In developed areas, up to 50 percent of rainwater or snowmelt becomes surface runoff.¹²
- In downtown areas, 90 percent or more of precipitation becomes runoff.¹³

This effect is apparent in Michigan:

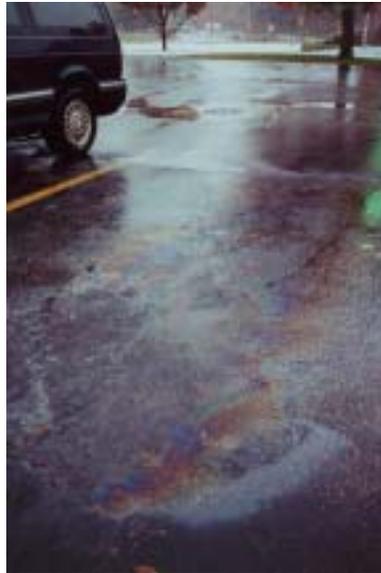
- From 1964 to 1995, development-caused runoff in the Rouge River watershed increased the frequency of peak flooding levels by four times.¹⁴ Development caused more water to flow immediately downstream as opposed to evaporate or filter into the water table.
- Sprawling development in the Detroit metro area built between 1982 and 1997 diverts over 8 billion gallons of water from the underground water table annually.¹⁵

Runoff Pollutes Drinking Water and Degrades Wildlife Habitat

Pollution from runoff causes significant problems for communities across the state. Contaminated drinking water must be filtered and treated before public use—which is harder and more expensive to do with more polluted water. Runoff also damages wildlife habitat and makes waterways less suitable for recreation.

Polluting Drinking Water

A source of clean drinking water is one of the most important requirements for a healthy community. Natural areas filter pollutants out of runoff and keep drinking water sources clean, making them a valuable part of the natural infrastructure that supports communities across the state.¹⁶ Because natural areas provide clean water for free, their value often goes unrecognized



Patricia Pennell, www.raingardens.org

Runoff from paved areas can carry pollutants (like the oil in this parking lot) into rivers.

and unincorporated into planning decisions.

In Michigan, public water supply systems use over 1.2 billion gallons of water per day. Close to 80 percent of that water comes from surface sources, including the Great Lakes and nearby rivers.¹⁷ When this water is not clean, public water supply agencies have to spend money building and operating water treatment plants to remove contaminants, or risk making people sick.¹⁸

Runoff can make water supplies more polluted and increase water treatment costs for local governments. For example, New York City estimated that expanded development in the Catskill Mountains would pollute the city's water supply reservoirs, requiring up to \$8 billion for a new treatment plant. The city determined that preserving natural areas to protect the reservoirs would ensure clean water for \$5 billion to \$7 billion less.¹⁹

Runoff can contain a variety of harmful contaminants that impair drinking water quality and threaten public health, including fallen air pollution, pesticides, and pollution from roads, like oil, salt, sediment and bits of rubber. Some of these chemicals are toxic, such as lawn care pesticides

and diesel exhaust particles that fall back to the ground.

Other contaminants can become toxic during the drinking water treatment process. Drinking water treatment plants often use chlorine to kill the bacteria in the water before pumping it into homes and businesses. While this step protects the public from bacterial infections, chlorine treatment can produce byproducts when it reacts with organic pollutants and sediments that are also in the water. These chlorinated byproducts, such as trihalomethanes and haloacetic acids, are suspected to cause birth defects, miscarriages, and cancer.²⁰ Chlorination tends to be the treatment of choice in the Great Lakes region.²¹

Degrading Wildlife Habitat

Runoff can also reduce the ability of a waterway to support a full, diverse and healthy range of wildlife—reducing the capacity of the ecosystem to absorb and filter pollution, or to support activities like recreational fishing.

Runoff comes in large amounts after rainstorms, eroding stream channels and destabilizing stream banks, increasing the amount of sediment in the water.²² These changes disrupt habitat for aquatic organisms and pollute the water.

Runoff also carries nutrients like phosphorus and nitrate compounds. These chemicals promote excessive growth of harmful aquatic vegetation like algae. As this vegetation dies and decays, it removes oxygen from the water, which can kill local species of aquatic plants and fish. This process is known as eutrophication, and it makes waterways less able to support fishing, recreation, industry and drinking.²³

Increased pollution and degraded habitat kill sensitive species and lead to a shift toward more pollution-tolerant insects and weeds. Waterways surrounded by urban areas and with high levels of treated sewage discharge tend to have an impaired aquatic community, with a narrow range of

pollution-tolerant species.²⁴ Waterways fed by land with a large amount of forest and wetlands are more likely to have a full and healthy aquatic community. Forests and wetlands provide a buffer from runoff pollution and help to maintain a healthy supply of water, food and habitat for sensitive species.²⁵

Runoff Causes Flooding and Sewer Overflows

Runoff causes flooding in downstream areas by increasing the levels of water in a stream immediately after a storm. In some areas, flooding overwhelms outdated sewage infrastructure, spilling raw or partially-treated sewage into rivers and the Great Lakes.

Increasing Flooding

Runoff increases the amount of water reaching a waterway after a storm and raises the elevation of the flood plain, leading to higher flood vulnerability in downstream areas.

With 30 to 60 days of thunderstorms per year, Michigan can experience serious flooding.²⁶

- Approximately six percent of Michigan's land is flood-prone, threatening about 200,000 buildings.²⁷
- Flooding is the leading cause of disaster declarations by the governor or the president.²⁸



Runoff carrying sediment and pollution into Emmons Creek, in Caledonia, MI.

www.raingardens.org

- Michigan's annual flood-related damages are estimated to be between \$60 and \$100 million.²⁹
- After flooding in May 2004, almost 34,000 people filed disaster claims with the Federal Emergency Management Agency, requesting more than \$50 million in assistance.³⁰

The experience of New Brunswick, New Jersey illustrates the connection between increased runoff and intensified flood damage. After Hurricane Floyd dropped 11 inches of rain on the New Brunswick area in 1999, the Raritan River escaped its banks and inundated part of the city, causing extensive damage. Upstream, development had added more than 2,700 acres of impervious surface (an 18.8% increase) in the previous 15 years.³¹ The extra water diverted into the Raritan River by runoff from this development undoubtedly made the flooding damage in New Brunswick more extensive.

Sewage Overflows

Some storm drains are combined with sewage systems, which deliver contaminated water to a treatment plant. After heavy rainfall, these systems can overflow, dumping raw or partially-treated sewage into waterways. The U.S. EPA estimates that every year, trillions of gallons of untreated human sewage are discharged from such overflows.

In 2004, stormwater runoff led to the discharge of more than 27 billion gallons of sewage into Michigan waterways, and ultimately to the Great Lakes.³²

Sewage discharge can contaminate waterways with fecal bacteria from human waste, making rivers and lakes unsafe for swimming or drinking.³³ In 2004, Michigan officials closed a swimming beach or



A stormwater outfall discharging directly into a waterway.

issued a bacterial contamination advisory for a total of 255 days (by county).³⁴

For Additional Information

For further background on the causes and effects of stormwater pollution, see:

- *Urbanization Impacts on Aquatic Resources*, Public Sector Consultants for the Michigan Land Use Leadership Council. Available at www.michiganlanduse.org/resources/councilresources.htm
- *Stormwater Strategies: Community Responses to Runoff Pollution*, Natural Resources Defense Council. Available at www.nrdc.org/water/pollution/storm/stoinx.asp
- *Site Planning for Urban Stream Protection, Chapter 2: The Importance of Imperviousness*, The Center for Watershed Protection. Available at www.cwp.org/SPSP/TOC.htm

Michigan Watersheds at Risk from Contaminated Runoff

Watersheds in Michigan with intermediate levels of impervious surface cover and high levels of growth are at risk of developing water quality problems caused by runoff from new development. As future development expands into these areas, more contaminated runoff is likely to enter local waterways and flow downstream to the Great Lakes.



Development near rivers harms water quality.

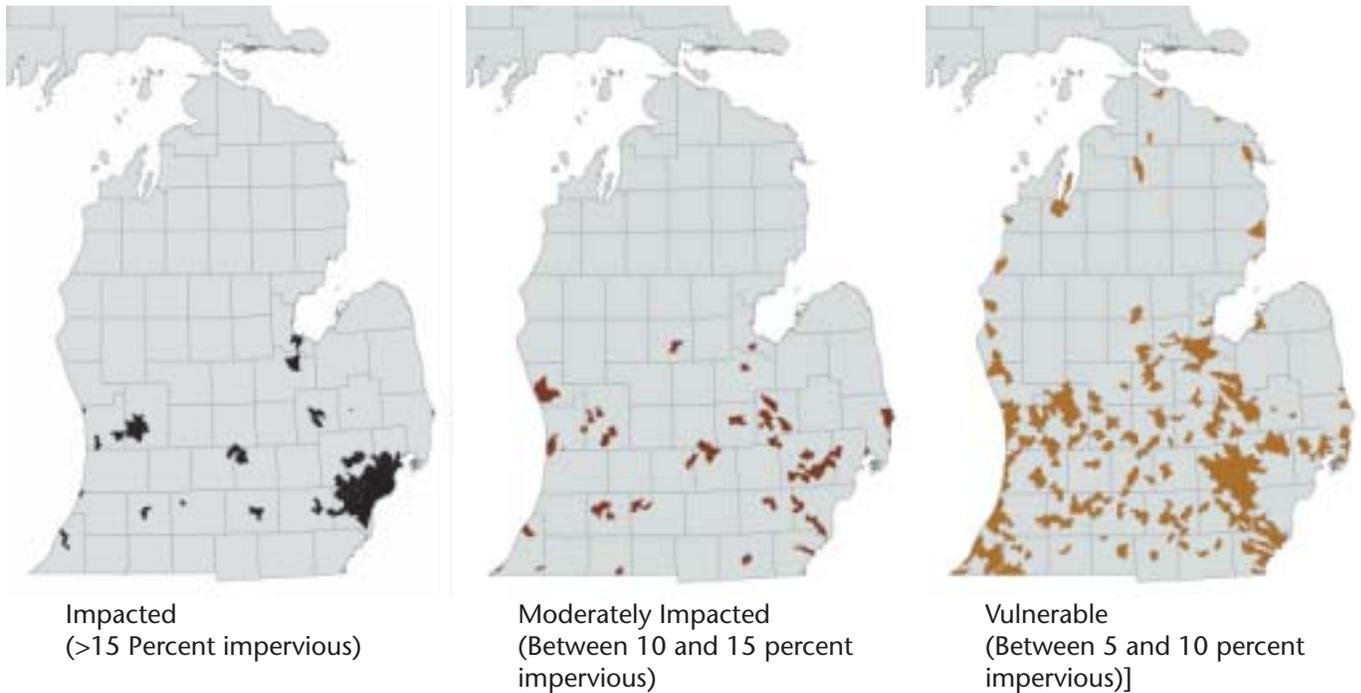
Impervious Surface and Watershed Health

The amount and location of impervious surface in watersheds is closely connected to the health of downstream waterways.

- Pollution problems grow as urbanization increases, as forest cover decreases, and as riparian buffers between development and waterways decrease.³⁵
- Watersheds with a large amount of forested cover, a large riparian buffer, and low levels of impervious surface tend to have better water quality. When a watershed is developed to the point where 25 percent or more of the land is impervious, severe water quality degradation results.³⁶
- Water quality problems tend to become apparent when 5 to 10 percent of a watershed is covered with impervious surfaces. Adding more impervious surface leads to more serious water quality problems.³⁷

A significant number of watersheds in Michigan are vulnerable to development-

Figure 1: Impervious Cover in Michigan Watersheds



caused runoff and water quality problems. Based on analysis of 2001 land use data obtained from the Michigan Department of Environmental Quality, areas in the urban cores of major cities in Southern Michigan have the highest levels of impervious surface. Watersheds surrounding these areas have intermediate levels of impervious surface coverage and still retain significant natural areas that mitigate water pollution. (See Methodology for analysis description.)

As shown in Figure 1, of Michigan's roughly 1,650 sub-watersheds:

- 15 percent have between 5 and 10 percent impervious cover and are vulnerable to developing significant water quality problems with increased development.
- Another 4 percent have between 10 and 15 percent impervious cover and are moderately impacted.
- 5 percent have more than 15 percent impervious surface and are impacted.

Watersheds in heavily urbanized areas tend to have the most severe water quality problems in the state. Some watersheds in central Detroit have up to 40 percent of their land area covered by impervious surface. Waterways in these areas receive heavy loads of pollution from stormwater runoff, in addition to industrial discharge and sewage treatment plant discharge.

Vulnerable watersheds tend to be in the same locations that are under increasing pressure from development—the outlying areas of major population centers.

In 2001, the Michigan Land Resource Project, an initiative of the Frey Foundation and the W.K. Kellogg Foundation on behalf of the Michigan Economic and Environmental Roundtable, projected what the state would look like in 40 years if business as usual continued. They concluded that Michigan would add over 4 million acres (6,250 square miles) of new development by 2040, nearly tripling the amount of built land.³⁸

In Southeast Michigan, local governments forecast a 36 percent increase in

developed land from 2000 to 2030. The addition of a half-million more people (a 12 percent increase in population), coupled with more households and land zoned for low-density development, could drive land use to increase at least as fast as recent trends.³⁹

If recent development patterns continue, in addition to growing amounts of built land, many more Michigan waterways will succumb to the effects of stormwater runoff pollution.

Rapidly Growing Municipalities

Southeast Michigan is the center of development activity in the state, followed by

Southwestern Michigan near Grand Rapids.

Nearly 23,000 permits for single-family residences—a proxy measure for residential development characteristic of “sprawl”—were issued in Southeast Michigan in 2004, 55 percent of all such permits issued in the state. Over 5,500 permits were issued in the area surrounding Grand Rapids, accounting for 15 percent of the state-wide total.

Figure 2 shows the number of building permits issued by municipality or unincorporated county across the Lower Peninsula.

Figure 3 shows the municipalities that issued more than 200 building permits in 2004, plus counties that issued over 500 building permits in unincorporated areas. These areas make up the 43 most rapidly developing municipalities in the state.

Figure 2: Building Permits Issued for Single-Family Residences in 2004

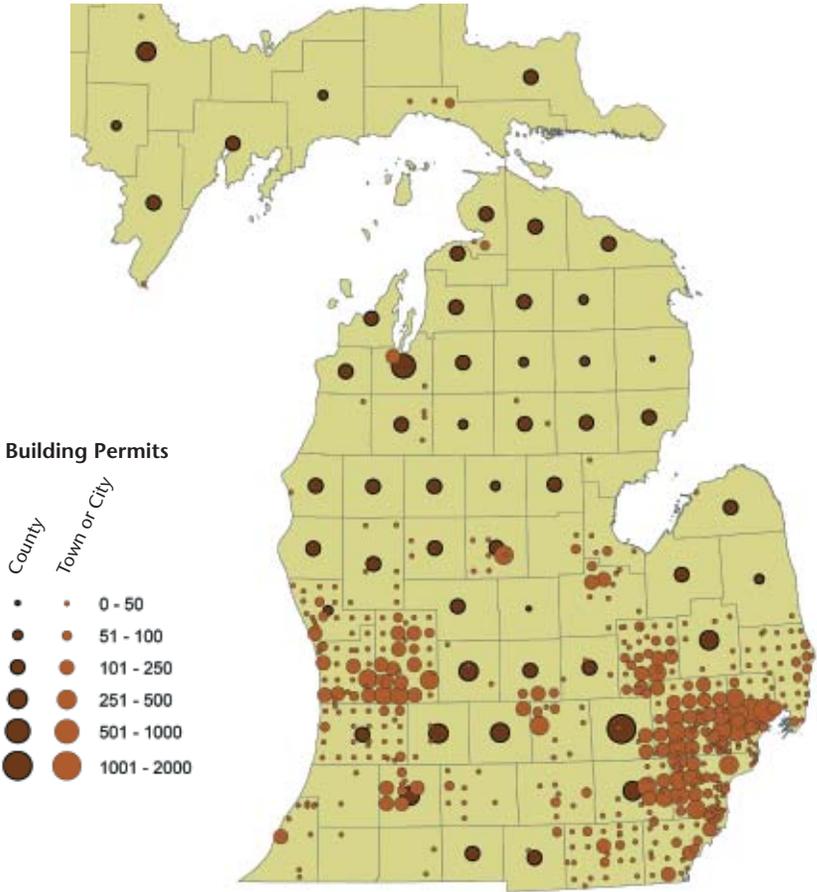
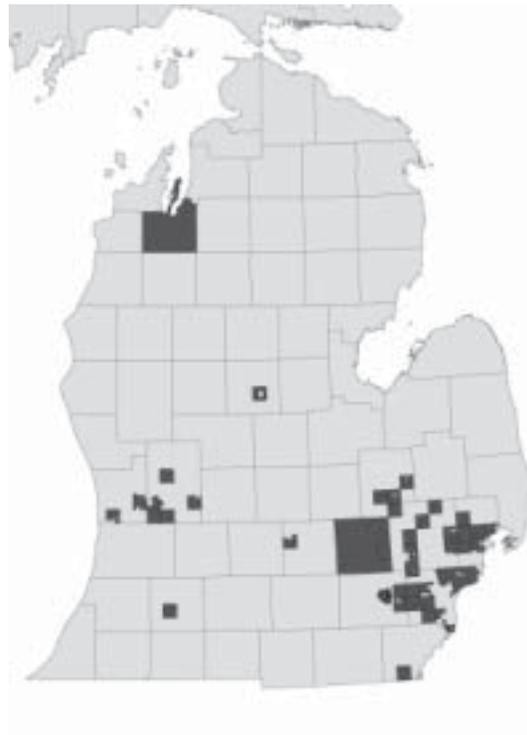


Figure 3: The Most Rapidly Developing Municipalities and Counties in Michigan



Watersheds in Areas of Rapid Growth Are Most at Risk

Watersheds in rapidly developing communities are most at risk for water quality degradation caused by runoff from new development. We define the most at-risk communities as areas that issued more than 200 building permits for single family homes in 2004 and occupy watersheds vulnerable to water quality decline (between 5 and 15 percent impervious surface).

These areas are primarily surrounding Detroit and Grand Rapids, with other important areas near Kalamazoo, Lansing and Traverse City, including:

- **Southwest Detroit Metro Area:** Ann Arbor, Ypsilanti, Superior, Canton, Van Buren, Romulus, Huron, Brownstown and Bedford;

- **Northwest Detroit Metro Area:** Clinton, Sterling Heights, Troy, Chesterfield, Macomb, Shelby, Rochester Hills, Washington, Oxford, Independence, White Lake, Commerce, Novi, Northville, Davison, Grand Blanc, Holly, Mundy, Brighton and unincorporated Livingston County;
- **Grand Rapids Area:** Lowell, Plainfield, Gaines, Byron, Wyoming, Georgetown and Holland;
- **Additional Areas:** Portage, Delhi and Union, and Grand Traverse County.

These areas are shown in Figure 4. Table 1 lists the number of building permits in each area in 2004. Figure 5 shows a close-up view of vulnerable watersheds and rapidly developing communities in Southeast Michigan.

Figure 4: Communities Most at Risk of Water Quality Degradation Caused by Runoff from New Development

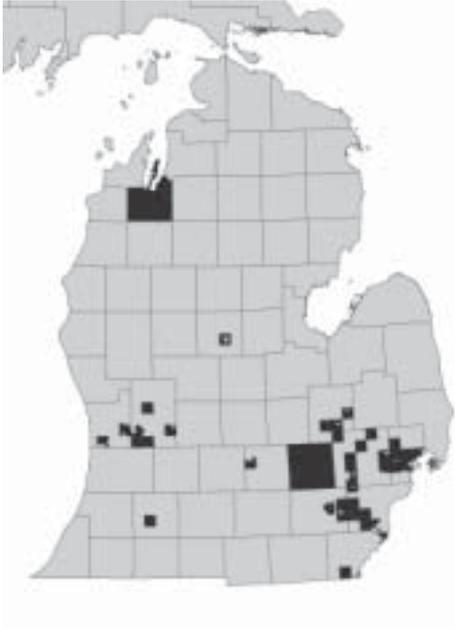


Figure 5: Rapidly Developing Towns and Vulnerable Watersheds in Southeast Michigan

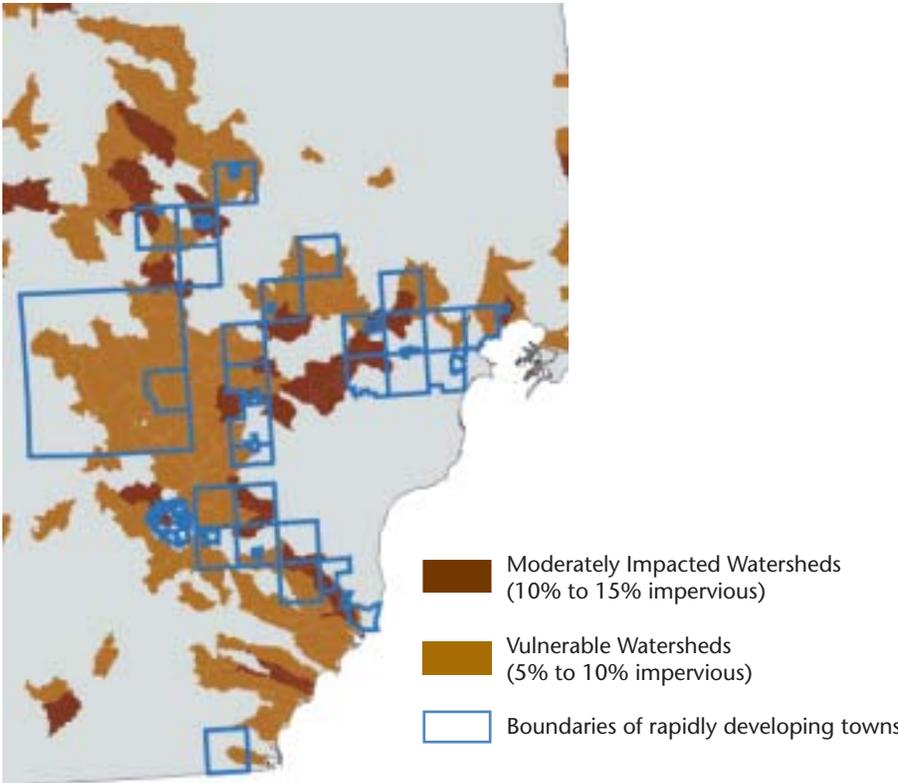


Table 1: Number of Single-Family Home Building Permits Issued in 2004 in At-Risk Municipalities

	Town	County	Permits Issued for Single-Family Homes in 2004
1	Livingston County	(Unincorporated)	1,563
2	Macomb Township	Macomb	1,087
3	Shelby Township	Macomb	755
4	Chesterfield Township	Macomb	663
5	Sterling Heights	Macomb	621
6	Grand Traverse County	(Unincorporated)	581
7	Novi	Oakland	505
8	Ypsilanti Township	Washtenaw	495
9	Northville Township	Wayne	488
10	Van Buren Township	Wayne	469
11	Huron Township	Wayne	465
12	Lowell Township	Kent	399
13	Canton Township	Wayne	396
14	Washington Township	Macomb	369
15	Georgetown Township	Ottawa	353
16	Brownstown Township	Wayne	343
17	White Lake Township	Oakland	339
18	Union Township	Isabella	328
19	Commerce Township	Oakland	326
20	Grand Blanc Township	Genesee	316
21	Byron Township	Kent	314
22	Troy	Oakland	311
23	Rochester Hills	Oakland	302
24	Ann Arbor	Washtenaw	283
25	Delhi Township	Ingham	266
26	Gaines Township	Kent	252
27	Independence Township	Oakland	246
28	Romulus	Wayne	245
29	Mundy Township	Genesee	244
30	Oxford Township	Oakland	242
31	Bedford Township	Monroe	241
32	Holly Township	Oakland	236
33	Brighton Township	Livingston	227
34	Clinton Township	Macomb	219
35	Wyoming	Kent	217
36	Plainfield Township	Kent	214
37	Superior Township	Washtenaw	211
38	Portage	Kalamazoo	209
39	Davison Township	Genesee	207
40	Holland Township	Ottawa	201

Low-Impact Development and Smart Growth Can Prevent Water Pollution

Irresponsible land use creates contaminated runoff at two separate levels. At the level of the individual development, traditional stormwater management practices treat stormwater runoff as a waste product, creating more runoff at a given site by using gutters and drains to dispose of runoff in ponds, creeks and sewers. These practices at best fail to take advantage of natural features of the landscape that could minimize pollution—and at worst, reduce the ability of the landscape to filter pollution out of the water.

At the aggregate, community-wide level, sprawling growth patterns create larger amounts of runoff for a given number of residents and can encroach into critical areas of the ecosystem. For example, a community of low-density development with a large network of roadways along a river will impact a larger area and cause greater amounts of runoff than a high-density, low-impact development, while disrupting the natural water cleaning ability of the land around the waterway. Together, sprawling development and traditional stormwater management pollute waterways.

Two approaches are necessary to solve the problem—low impact development and smart growth. At the site level, low-impact

development techniques aim to make the built environment function more like the natural environment. By customizing the approach to natural features of the landscape, incorporating green spaces, planting native landscaping, using absorbent surfaces, and implementing other simple, cost-effective and low-tech methods, low-impact development manages stormwater close to where it falls. Low-impact practices capture and treat stormwater on-site, allowing runoff to soak into the ground, evaporate or be stored for later use in irrigation.

At the community-wide level, smart growth practices reduce the area of impact and protect critical parts of the ecosystem. Smart growth uses strategic open spaces, infill development, town center redevelopment and clustered, higher-density design to minimize runoff in the aggregate.

Combining these two approaches in a comprehensive plan to manage growth will magnify the benefit of individual policies and lead to cleaner water locally and in the Great Lakes. There are a variety of additional benefits as well, including more beautiful and desirable urban areas; reduced costs for municipalities; increased developer profits and improved quality of life.

Principles of Low-Impact Development

Underlying low-impact development is a set of principles that focus on creating a built landscape with the function of a natural landscape—or retrofitting an urban area to restore ecological function. Low-impact principles include:⁴⁰

- 1) Focus on prevention of runoff rather than mitigation;
- 2) Conserve natural landscape features and processes to retain stormwater and filter pollution;
- 3) Emphasize simple, non-structural, low-tech and low-cost methods;
- 4) Manage runoff as close to the source as possible;
- 5) Minimize effective impervious surface area by directing runoff to "rain gardens" and other natural infrastructure;
- 6) Encourage private landowner stewardship to reduce stormwater runoff;
- 7) Take a "fix-it-first" approach to public infrastructure, prioritizing the updating and separating of stormwater and sewer systems; and
- 8) Customize the approach to the land under consideration.

For Additional Information

For more information on low-impact development, see:

- *Catching the Rain: A Great Lakes Resource Guide for Natural Stormwater Management*, American Rivers. Available at www.americanrivers.org.
- "Low-Impact Development," Chapter 12 of *Stormwater Strategies: Community*



A "rain garden" designed to absorb and treat runoff from a parking lot.



Permeable pavement.

Responses to Runoff Pollution. Natural Resources Defense Council. Available at www.nrdc.org.

- *Low-impact Development: Urban Design Tools*, a web page addressed to watershed managers, created by the U.S. EPA and the Low-Impact Development Center. Available at www.lid-stormwater.net
- *Low-Impact Development Design Strategies: An Integrated Design Approach*, Prince George's County, Maryland and U.S. EPA. Available at www.epa.gov/owow/nps/lid.
- The Green Roof Research Program at Michigan State University: www.hrt.msu.edu/greenroof.

Principles of Smart Growth

Low-impact development principles work equally well in a variety of situations—from urban retrofits to new sprawl-style developments in rural areas. Thus, a broader approach to creating sustainable communities is also necessary to maximize the impact of low-impact development.

Low-density developments tend to have large amounts of impervious surface serving a smaller number of people. As a result, communities zoned for low-density development impact a much larger area. According to research at the U.S. EPA, low-density development (1 unit per acre and 20 percent impervious cover) creates almost three times as much runoff as high-density development (8 units per acre and 65 percent impervious cover).⁴¹

Several additional studies document the benefits of higher-density development in reducing runoff:

- Researchers in Connecticut found that low-density sites produce 95 percent more runoff during construction than high-density sites.⁴²
- The Chesapeake Bay Foundation found that high density developments convert 75 percent less land area, create 42 percent less impervious surface and produce 41 percent less runoff than low-density development.⁴³
- The New Jersey *State Plan* calls for higher-density development around town centers and infill development in areas with existing infrastructure. Researchers at Rutgers University found that this plan would reduce runoff by 30 percent versus business as usual.⁴⁴

Accordingly, low-impact development techniques should be used in conjunction with a broader approach to creating healthy, sustainable communities following the

principles of smart growth. Ideally, a smart growth community will:⁴⁵

- Mix land uses;
- Use compact building and community design, built around vital town centers;
- Create a range of housing opportunities;
- Create walkable neighborhoods;
- Foster distinctive, attractive communities;
- Preserve open space, farmland, natural beauty and critical environmental areas;
- Invest in and maintain existing communities;
- Restore and redevelop abandoned buildings and sites;
- Provide a variety of transportation choices;
- Make development decisions predictable, fair and cost-effective;
- Encourage community involvement in planning and development decisions; and
- Coordinate planning across town and regional boundaries.

For Additional Information

For additional detail on the core principles of smart growth, a brief history of the issue, and a detailed list of policies associated with smart growth, please see the American Planning Association's *Policy Guide on Smart Growth*, available at www.planning.org.⁴⁶ See also *Smart Growth for Clean Water: Innovative Strategies for NPDES Phase II Stormwater Management in Michigan*, a report by the Michigan Environmental Council, available at www.mecprotects.org.

Local Governments Should Promote Low-Impact Development and Smart Growth

Local governments are the center of land-use decision-making in Michigan. Villages, townships, cities and counties all play a role in how development proceeds within their boundaries.

Local governments regulate development using two main tools: master growth plans and zoning ordinances. The master planning process represents a long-term vision for how, where and when growth is intended to occur—and what natural features or resources deserve preservation. Zoning ordinances are the nuts and bolts of the master plan, identifying areas where residential, commercial or industrial development is allowed and setting rules for design and construction. Both of these forums offer opportunities to protect water quality by promoting low-impact development and smart growth.

A comprehensive approach to policy reform will have the greatest effect, combining the best features of on-site low-impact development techniques and community-wide smart growth strategy.

Policies that will protect waterways from new sources of stormwater runoff include establishing buffer zones around waterways (in both the master plan and the zoning

ordinance) and legally establishing a no net runoff standard as a part of the zoning code. In addition, communities in more heavily urbanized areas can set up retrofit programs to mitigate the effects of pre-existing development. These changes need to be coupled with broader smart growth strategies, including incentives for clustered development around town-centers, infill development and redevelopment, strategic open land preservation and coordinated planning across local and regional boundaries.

For Additional Information

For a guide to local government and land use planning in Michigan, see:

- Citizen's Guide to Land Use Planning, *Huron River Watershed Council*, available at www.brwc.org/program/land.htm.
- Better Site Design: A Handbook for Changing Development Rules in Your Community, *Center for Watershed Protection*. Available for purchase, with associated free resources available at: www.cwp.org/bfb_better_site_design.htm

Creating Buffer Zones Around Waterways

Waterways with healthy riparian areas are much less vulnerable to runoff pollution. Preserving these areas is an important way local governments can prevent water quality problems, while also offering beautiful natural areas for citizens to enjoy.

Community master plans should identify riparian areas as a critical natural resource and source of clean drinking water. Accordingly, the plan should establish the intent of preserving a natural buffer zone along and around waterways. The state of New Jersey uses a 150 to 300-foot buffer to protect creeks, streams, rivers, reservoirs and headwaters that are important sources of drinking water or have other important values.⁴⁷

However, master planning documents are not legally binding—rather, they indicate the vision for how the community will grow and develop over time. To legally require preservation of a buffer zone around a waterway within a locality, a buffer zone ordinance would be required. The ordinance would establish specific rules for the establishment, protection and maintenance of riparian areas along stream corridors.

A model buffer zone ordinance establishing a 200 foot buffer can be found at the Center for Watershed Protection's Stormwater Manager's Resource Center, online at www.stormwatercenter.net. Additional information about stream buffer design can be found in *The Architecture of*



Urban Stream Buffers, a publication of the Center for Watershed Protection available at www.cwp.org.

Establishing a “No Net Runoff” Standard for New Development in Areas Outside the Urban Core

A community zoning ordinance establishes rules that govern the design and construction of all types of development, from residential areas to commercial shopping areas and office complexes to industrial sites.

Zoning regulations offer an opportunity to require new development to prevent stormwater runoff. The key features of a low-impact stormwater ordinance should include:

- 1) A standard of no net runoff from new development. An appropriate standard would be replication of pre-development runoff characteristics during a 2-year, 24-hour storm event. This level of performance would offer significant benefits in terms of detaining runoff and treating runoff contamination. In addition, research has shown that this level of performance protects downstream areas from flooding even during a 100-year storm.⁴⁸
- 2) Flexibility for developers to use a wide range of non-structural low-impact development practices to achieve that standard.
- 3) Revision of outdated requirements that interfere with low-impact development practices or promote greater levels of impervious surface, including requirements for excessively wide streets, large setbacks or traditional stormwater infrastructure.

The zoning ordinance should specifically endorse and encourage low-impact

development features that residents and local leaders find desirable, while revising older parts of the ordinance that prohibit effective stormwater management. For example, the town of Lacey in Washington State has adopted rules eliminating legal barriers to the use of zero-impact principles. The goal of the ordinance is to allow developments to achieve near-zero effective impervious surface. However, the ordinance is voluntary and no incentives or requirements to use low-impact techniques yet exist. To date, two separate developers have taken advantage of the ordinance. The Villages at Hicks Lake and the Long Lake Retirement Community plan to incorporate a range of low impact techniques to achieve zero impact, including narrower roads, forest conservation, bioretention swales and permeable pavement.⁴⁹

In 1996, the Center for Watershed Protection gathered experts together in a site-planning roundtable and produced a list of 22 model development principles.⁵⁰ These principles, plus a codes and ordinances worksheet, can help community groups evaluate local zoning policy and identify areas where changes to reduce impervious cover, conserve natural features and prevent stormwater pollution are necessary.

For Additional Information

For further information on model development principles, see:

- *Site Planning Model Development Principles*, Center for Watershed Protection. Available at www.cwp.org/22_principles.htm.
- The “Codes and Ordinances” worksheet at the same site offers tools to evaluate your own community.
- A technical support manual with greater detail on each design principle and how to incorporate them into municipal code is available for purchase: *Better Site Design: A Handbook for Changing Development Rules in Your*

Community, Center for Watershed Protection, www.cwp.org. Associated presentations and other free resources are available at www.cwp.org/bfb_better_site_design.htm.

Retrofit Programs in the Urban Core

Policies that reduce runoff from new development won't be as effective in more heavily urbanized areas of Michigan. Community organizations located in these areas can instead work with their local governments to establish retrofit programs to reduce the impact of existing development on water quality. Low-impact development principles are effective for retrofit projects as well as for new development.

For example, Chicago has established a requirement that all new or refurbished roofs in the city either use living material or a reflective surface. The intent of the rule is focused on the heat gain from so many black roofs and to promote energy efficiency. However, green roofs, such as the rooftop meadow atop Chicago City Hall, will also significantly reduce stormwater runoff.⁵¹

Seattle has established a retrofit program to address runoff from roadways called “SEA Streets.” The program seeks to retrofit the ditch and culvert drainage system in the northern part of the city with innovative natural approaches to manage runoff. The first demonstration project included installation of vegetated swales, gardens, tree preservation and planting, and street improvements that reduce impervious surface cover.⁵²

Local governments in Michigan should follow these examples and create their own retrofit programs. Low-impact development principles can help restore natural functions in these areas while improving natural beauty, energy efficiency, and quality of life.

Funding Retrofit Projects

Funding will likely be a major challenge facing any new retrofit project to improve urban stormwater infrastructure with low-impact techniques. The U.S. Environmental Protection Agency recommends the following resources to assist communities seeking funding for stormwater management:⁵³

- **An Internet Guide to Financing Stormwater Management** - This site was designed to help communities find ways to fund stormwater management projects. <http://stormwaterfinance.urbancenter.iupui.edu/>
- **Catalog of Federal Funding Sources for Watershed Protection** - The Catalog of Federal Funding Sources for Watershed Protection Web site is a searchable database of financial assistance sources (grants, loans, cost-sharing) available to fund a variety of watershed protection projects. <http://cfpub.epa.gov/fedfund/>
- **State Revolving Fund** - State Revolving Fund programs in each state and Puerto Rico are funded by EPA and operated like banks. Assets are used to make low- or no-interest loans. www.epa.gov/owm/cwfinance/cwsrf/index.htm

In addition, if Congress and state governments act on the recommendations of the Great Lakes Regional Collaborative (see Introduction), new programs and funding sources will be created.

Promote Broader Smart Growth Strategies

Low-impact development reforms will be most effective when coupled with a broader strategy to create healthy, sustainable communities.

There are a variety of reasons to adopt a smart growth strategy to guide long-term development. In terms of water quality, smart growth reduces the overall potential for runoff. Smart growth has a variety of additional benefits, including:

- Cost savings for municipalities;
- Enhanced tourism and other business opportunities;
- Vital neighborhoods;
- Community quality of life;
- Recreation, parks and open space; and
- Improved transportation options.

Smart growth strategies have to be implemented at the local, county, regional and state level. Locally, governments can promote

clustered development around town centers, infill development and redevelopment, and strategic open land preservation.

Because local governments can control their own growth decisions, but not those of neighboring areas, they should engage in coordinated planning across local and regional boundaries to create a plan for the future that is consistent across a wide area, and takes into account natural resources in a regional context. Local governments should also encourage leaders at the county and state level to facilitate the inclusion of smart growth principles in policies regulating growth and development.

Local governments in Michigan have the resources and tools to minimize the effect of development on water quality. By coupling low-impact development strategies with smart-growth principles in a comprehensive approach, communities can maximize the benefit of individual policies and create new patterns of land use. The rewards will include cleaner streams and rivers, fewer sewage spills, and healthier Great Lakes.



Patricia Pennell, www.raingardens.org



Patricia Pennell, www.raingardens.org

Low-impact development and smart growth techniques can prevent streams like Basset Creek (top) from turning into Whiskey Creek (bottom), and protect the Great Lakes from pollution.

Methodology

Impervious Surface Calculation

To calculate the levels of impervious surface in Michigan, we used two main data sources:

- 2001 land use data for Michigan's Lower Peninsula at 30 meters square resolution, obtained from the Michigan Geographic Data Library,⁵⁴ and
- U.S. Geological Survey watershed boundaries at the Hydrologic Unit Code-14 (HUC 14) level, obtained from the Michigan Geographic Data Library.⁵⁵

After obtaining the data, we used Geographic Information Systems software to analyze land use and calculate the levels of impervious surface in each watershed.

- 1) Using ArcView GIS software, we cut the land use file into pieces representing each HUC 14 watershed in the Lower Peninsula.
- 2) We analyzed each individual watershed land-use file to determine the area of each type of land, listed in Table 2.
- 3) We calculated the percentage of the

watershed covered by impervious surface, using the percentage of each land use type estimated to be impervious, as interpreted from work done by the Rouge Program Office to measure impervious surface coverage on various land uses in Southeast Michigan from aerial photographs, supplemented by similar studies of impervious cover from other locations.⁵⁶

Identifying At-Risk Watersheds

To identify at-risk watersheds, we looked at municipalities that issued more than 200 building permits for single-family residences in 2004 (or unincorporated areas of counties that issued more than 500 building permits) that contained a watershed with more than 5 percent but less than 15 percent impervious surface.

Building permit information for 2004 was compiled by the U.S. Census bureau.⁵⁷ We linked permit data to a GIS file representing Michigan villages, townships, cities and counties to produce the building permit maps in the report and calculate overlap with specific watershed areas.

Table 2: Estimated Percentage Impervious Cover by Land Use

Land Use Code	Land Use Category	Percent Impervious Surface
0	Background	EXCLUDED
1	Low-Intensity Urban	19%
2	High-Intensity Urban	51%
3	Airports	53%
4	Roads and Parking Lots	53%
5	Non-Vegetated Farmland	2%
6	Row Crops	2%
7	Forage Crops	2%
9	Orchards	2%
10	Herbaceous Openland	2%
12	Low-Density Trees and Shrubs	2%
13	Golf Courses and Parks	11%
14	Northern Hardwood	2%
15	Oaks	2%
16	Aspens	2%
17	Other Upland Deciduous	2%
18	Mixed Upland Deciduous	2%
19	Pines	2%
20	Other Upland Conifers	2%
21	Mixed Upland Conifers	2%
22	Upland Mixed Forest	2%
23	Water	EXCLUDED
24	Lowland Deciduous Forest	2%
25	Lowland Coniferous Forest	2%
26	Lowland Mixed Forest	2%
27	Floating Aquatic	2%
28	Lowland Shrubs	2%
29	Emergent Wetland	2%
30	Mixed Non-Forest Wetland	2%
31	Sand and Soil	3%
32	Bare Rock	50%
33	Mud Flats	2%
35	Other Bare / Sparsely Vegetated	5%

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